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EOCENE HORIZONS OF CALIFORNIA

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During the past few years geologists of California have been devoting considerable attention to the Eocene, with the result that three horizons are now recognizable. In order of their deposition these are the Martinez, Tejon, and Ione formations.

MARTINEZ FORMATION

The Martinez formation has so far been found in the Mt. Diablo region, Contra Costa County; in the Santa Monica Mountains, northwest of Los Angeles; and on the west side of the Santa Ana Mountains. It is characterized by sandstones and shales, not unlike those of the Chico (Upper Cretaceous) formation, and by a fauna strikingly similar to those of the eastern Midway formation, with which it is to be correlated. In the Santa Monica Mountains it is characterized by *Venericardia planicosta* var. *venturensis* var. nova, which is similar to *V. planicosta* Harris.[1] Several other new species have also been found, the most characteristic of which here described are from the Santa Monica Mountains.

Crassatellites branneri n.sp.—Shell about 55 mm. high, trigonal, slightly longer than high; beaks subcentral, prominent, deeply excavated front and back, incurved, with sides sloping equally and rapidly, most abrupt in advance, slightly convex behind; lunule cordate; anterior end broadly rounded; posterior truncated and flattened from the umbonal ridge to the cardinal and posterior margins. Surface marked by lines of growth and fine radiating lines which are especially apparent in worn specimens. Leland Stanford Junior University Paleontological Collection. Named in honor of Dr. J. C. Branner.

Lima perrini n.sp.—This giant circular lima has a thick shell with nacreous, and outer prismatic layer. The diameter is about

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[1] *Bull. Am. Pal.*, No. 4, p. 58, Fig. 13.

160 mm. The umbones are small and the cardinal margin slopes gradually to the posterior where it becomes rounded and grades into the circular margin below. The beaks are slightly excavated in front, and the margin slopes at a 35-degree angle into the rounded anterior margin. The hinge is very thick and has a deep wedge-shaped ligament pit sloping from the interior edge of the shell to the exterior edge at the anterior end of the hinge line. A single large sub-posterior muscle impression marks the interior of the shell. The surface is ornamented by many fine radiating lines, and the prismatic shell layer gives the surface a silken appearance. It belongs ·to the subgenus Acesta. Leland Stanford Junior University Paleontological Collection. Named in honor of Dr. J. Perrin Smith of Stanford University.

Pseudoliva reticulata n.sp.—Shell subconical, whorls four, spire low, suture linear. Altitude 20 mm., width 12 mm. Inner whorls almost covered by body whorl, which is concave. Aperture wide, posterior angular, anterior produced slightly into a canal. Outer lip simple, inner lip incrusted and marked by a fold revolving from the end of the canal around to the inner lip, representing the former positions of the end of the canal. Surface ornamented by longitudinal folds and spiral ribs; where these intersect, small tubercles develop. The middle of the body whorl is impressed by a single revolving line which forms a tooth where it is truncated on the outer lip. Leland Stanford Junior University Paleontological Collection.

Turritella maccreadyi n.sp.—Shell robust, apical angle broad; whorls eleven, rounded, with six or seven strong, nearly equally spaced, spiral ribs. The first five or six whorls are angulated like *T. martinezensis* Gb.[1] Surface below body whorl also ornamented by spiral lines, and whole surface marked by lines of growth. Aperture broad, outer lip slightly sinuous; inner lip sinuous, flattened, and twisted. Leland Stanford Junior University Paleontological Collection. Named in honor of Mr. George McCready of Guanoco, Venezuela.

Nautilus hallidayi n.sp.—Shell immense, being about 36 mm. in greatest diameter. The inner whorls are completely enveloped,

[1] *Geol. Surv. of California*, Paleontology, Vol. II, p. 169, Pl. 28; Fig. 51.

while the last whorl is more evolute. Dorsum rounded. Aperture elliptical, concave below where it envelops the early coils. The outer volution has a width slightly less than the remaining diameter of the shell. Sutures slightly inflected. Shell pearly. It is probably the oldest species of true nautilus known. Leland Stanford Junior University Paleontological Collection. Named in honor of Mr. T. W. Halliday of Spokane, Washington.

TEJON FORMATION

The Tejon formation occurs principally in Kern, Santa Barbara, Ventura, and Los Angeles counties, with a fringe along the eastern flank of the southern end of the Mt. Diablo Range. Smaller patches outcrop near the coast north of San Diego and in the Santa Ana Mountains. The formation consists of conglomerates, sandstones, and shales, and faunally is characterized by *Turritella uvasana* Conrad, *Morio tuberculatus* Gb., and *Venericardia planicosta* var. *horni.* Gb., which is very similar to *V. planicosta* var. *regia* Conrad of the Aquia formation of Maryland. Several new species have been found, the most striking among which are the following:

Cucullaea morani n.sp.—Shell thick, oblique, very convex; beaks large, broad, prominent, and about one-third the distance from the anterior, incurved and somewhat remote; area oval in shape and about two-thirds the length of the shell. Altitude 36 mm.; longitude 60 mm. Anterior margin broadly rounded and more prominent above; base nearly straight; posterior produced and sharply rounded; umbonal ridge prominent and runs to posterior margin; cardinal margin sloping at an angle of about 45 degrees. Surface marked by alternating single and double radiating ribs which are crossed by fine to coarse lines of growth. Locality one and one-half miles east of McCray Wells, Ventura County. Specimens in Leland Stanford Junior University Paleontological Collection. Named in honor of Mr. R. B. Moran of San Francisco.

Isocardia tejonensis n.sp.—Shell of medium size, thin; valves equal, inflated, rotund, completely closed, margins plain; beaks prosogyrous. Surface marked by concentric bandlike ribs, which become fine and nearly obsolete on the beaks. From one and one-half miles east of the McCray Wells, Ventura County. Specimens in Leland Stanford Junior University Paleontological Collection. This is the first species of *Isocardia* described from the Eocene of California.

Pinna lewisi n.sp.—Shell thin, pearly, mytiliform, equivalve, truncate, and wholly open behind, hinge line long; valves triangular, the apical angle being about 45 degrees; convex along the center line and flaring at the margins. Base of shell notched in the middle and convex on either side. Surface marked by five indistinct radiating ribs and concentric lines of growth. From one and one-half miles east of McCray Wells, Ventura County. Specimen in Leland Stanford Junior University Paleontological Collection. Named in honor of Mr. J. O. Lewis of San Francisco.

IONE FORMATION

The Ione formation is typically represented on the east side of the San Joaquin Valley, extending from a point twenty miles east of Merced to a point forty miles south of Auburn. It is to be correlated with the marine Eocene sediments of Corral Hollow, those in the northern part of the Mt. Diablo Range, and with those on the eastern flank of the St. Helena Range. The formation is characterized by clayey shales and sandstones and by such fauna as *Turritella merriami* Dickerson[1] and *Venericardia planicosta* var. *ionense* var. nova, which is similar to *V. marylandica* Harris[2] and *V. potopacoensis* Harris.[3] The formation is probably to be correlated with the Nanjemoy, which, it is thought by Harris, ranges higher than Chickasawan and Upper Lignitic.

The three horizons each have typical faunas among which the *Venericardia* and *Turritella* are represented by very characteristic species. The evolution of *Venericardia planicosta* Lamarck seems to have been from a square-ribbed variety to one with broad, rounded ribs, and then finally to a smooth form. Conditions were favorable for its more rapid evolution during the Tejon period and a wide range of variation is noted.

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[1] *Bull. Dept. Geol., Univ. of Calif.*, Vol. VII, No. 12 (April, 1913), p. 284, Pl. 13, Fig. 6.

[2] *Maryland Geol. Surv.*, "Eocene," pp. 178–79, Pl. XI, Figs. 4–7.

[3] *Ibid.*